

Application Serial No. 10/615,041  
Reply to Office Action of November 25, 2009

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PATENT  
Docket: CU-5982**Amendments to the Claims**

The listing of claims presented below replaces all prior versions, and listings, of claims in the application.

**Listing of claims:**

1. (currently amended) A volume hologram recording photosensitive composition, comprising a fluorine-containing photoreactive compound represented by the following formula (1), a binder resin and a sensitizing dye which gets transparent by light-exposure or treatment after the light-exposure:

Formula (1)



wherein each  $R^1$  and  $R^2$  in the formula (1) is independently an epoxy group or an oxetanyl group, and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms, n is an integer of 1 or more; [[and]]

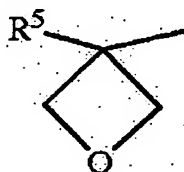
wherein the fluorine-containing photoreactive compound is the only fluorine-containing photoreactive compound represented by the formula (1); and  
wherein the binder resin comprises an organic-inorganic hybrid polymer.

- 2-4. (cancelled)
5. (previously presented) The volume hologram recording photosensitive composition according to claim 1, wherein each of  $R^1$  and  $R^2$  is an epoxy group.
6. (previously presented) The volume hologram recording photosensitive composition according to claim 1, wherein each of  $R^1$  and  $R^2$  in the formula (1) is an oxetanyl group represented by the following formula (2):

Formula (2)

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wherein R<sup>5</sup> is a hydrogen atom or an alkyl group having 1 to 10 carbon atoms.

7. (original) The volume hologram recording photosensitive composition according to claim 1, wherein each of R<sup>3</sup> and R<sup>4</sup> in the formula (1) is independently a single bond or a linear hydrocarbon group.
8. (original) The volume hologram recording photosensitive composition according to claim 1, which further comprises a photopolymerization initiator.
9. – 10. (cancelled)
11. (previously presented) The volume hologram recording photosensitive composition according to claim 1, which further comprises a second refractive index modulating component other than the fluorine-containing photoreactive compound.
12. (previously presented) The volume hologram recording photosensitive composition according to claim 11, wherein a combination of ingredients for forming a refractive index difference is any one selected from the group consisting of the following (1) to (4):
  - (1) a combination comprising the fluorine-containing photosensitive compound represented by the formula (1), a binder resin having a refractive index different from that of the fluorine-containing photosensitive compound, and a radical photopolymerizable compound which is the second refractive index modulating component having a refractive index different from that of the fluorine-containing photosensitive compound;
  - (2) a combination comprising the fluorine-containing photosensitive compound represented by the formula (1), a binder resin having a refractive index different from that of the fluorine-containing photosensitive compound, and a cationic

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photopolymerizable compound which is the second refractive index modulating component having a refractive index different from that of the fluorine-containing photosensitive compound;

(3) a combination comprising the fluorine-containing photosensitive compound represented by the formula (1), and two or more radical photopolymerizable compounds which are the second refractive index modulating components each having a refractive index different from that of the fluorine-containing photosensitive compound; and

(4) a combination comprising the fluorine-containing photosensitive compound represented by the formula (1), a radical photopolymerizable compound which is the second refractive index modulating component having a refractive index different from that of the fluorine-containing photosensitive compound, and a cationic photopolymerizable compound which is the second refractive index modulating component having a refractive index different from that of the fluorine-containing photosensitive compound.

13. (previously presented) The volume hologram recording photosensitive composition according to claim 1, which further comprises metal fine particles having a refractive index different from that of the fluorine-containing photosensitive compound represented by the formula (1).

14. (cancelled)

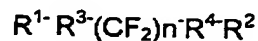
15. (previously presented) The volume hologram recording photosensitive composition according to claim 1, wherein the sensitizing dye is at least one selected from the group consisting of cyanine type dyes, merocyanine type dyes, coumarin type dyes, ketocoumarin type dyes, and cyclopentanone type dyes.

16. (currently amended) A volume hologram recording photosensitive medium, having a hologram recording section made of a volume hologram recording photosensitive composition comprising a fluorine-containing photoreactive compound represented by the following formula (1), a binder resin and a sensitizing dye which gets transparent by light-exposure or treatment after the light-exposure:

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Formula (1)



wherein  $R^1$  and  $R^2$  in the formula (1) is independently an epoxy group or an oxetanyl group, and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms,  $n$  is an integer of 1 or more; [[and]]

wherein the fluorine-containing photoreactive compound is the only fluorine-containing photoreactive compound represented by the formula (1); and

wherein the binder resin comprises an organic-inorganic hybrid polymer.

17. (currently amended) A volume hologram having a hologram layer, wherein the hologram layer is formed by exposing, to light, a volume hologram recording photosensitive medium having a hologram recording section made of a volume hologram recording photosensitive composition comprising a fluorine-containing photoreactive compound represented by the following formula (1), a binder resin and a sensitizing dye which gets transparent by light-exposure or treatment after the light-exposure:

Formula (1)



wherein  $R^1$  and  $R^2$  in the formula (1) is independently an epoxy group or an oxetanyl group, and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms,  $n$  is an integer of 1 or more, at the hologram recording section,

wherein the hologram layer has 0.016 or more of refractive index modulation ( $\Delta n$ ) between its low refractive index region and its high refractive index region; [[and]]

wherein the fluorine-containing photoreactive compound is the only fluorine-containing photoreactive compound represented by the formula (1); and

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wherein the binder resin comprises an organic-inorganic hybrid polymer.

18. (currently amended) A volume hologram recording photosensitive composition, comprising a fluorine-containing photoreactive compound represented by the following formula (1), a binder resin and metal fine particles having a refractive index different from that of the fluorine-containing photosensitive compound represented by the formula (1):

Formula (1)



wherein  $R^1$  and  $R^2$  in the formula (1) is independently an acryloyl group or a methacryloyl group and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms, [[and]]  $n$  is an integer of 1 or more, and wherein the binder resin comprises an organic-inorganic hybrid polymer.

19. (previously presented) The volume hologram recording photosensitive composition according to claim 18, which further comprises a photopolymerization initiator.

20. (cancelled)

21. (previously presented) The volume hologram recording photosensitive composition according to claim 20, wherein the binder resin comprises at least one selected from the group consisting of a thermoplastic resin, a thermosetting resin, an organic-inorganic hybrid polymer, and an organic metal compound represented by the formula (4):

Formula (4)



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wherein M' represents a metal such as Ti, Zr, Zn, In, Sn, Al or Se, and R'' represents an alkyl group having 1 to 10 carbon atoms, and n' is the valence number of the metal M'.

22. (previously presented) The volume hologram recording photosensitive composition according to claim 18, which further comprises a sensitizing dye which is at least one member selected from the group consisting of cyanine type dyes, merocyanine type dyes, coumarin type dyes, ketocoumarin type dyes, and cyclopentanone type dyes.

23. (currently amended) A volume hologram recording photosensitive medium, having a hologram recording section made of a volume hologram recording photosensitive composition comprising a fluorine-containing photoreactive compound represented by the following formula (1), a binder resin and metal fine particles having a refractive index different from that of the fluorine-containing photosensitive compound represented by the formula (1):

Formula (1)



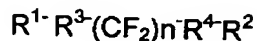
wherein each R<sup>1</sup> and R<sup>2</sup> in the formula (1) is independently an acryloyl group or a methacryloyl group, and each of R<sup>3</sup> and R<sup>4</sup> is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms, [[and]] n is an integer of 1 or more, and wherein the binder resin comprises an organic-inorganic hybrid polymer.

24. (currently amended) A volume hologram having a hologram layer, wherein the hologram layer is formed by exposing, to light, a volume hologram recording photosensitive medium having a hologram recording section made of a volume hologram recording photosensitive composition comprising a fluorine-containing photoreactive compound represented by the following formula (1), a binder resin and metal fine particles having a refractive index different from that of the fluorine-containing photosensitive compound represented by the formula (1):

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Formula (1)



wherein each  $R^1$  and  $R^2$  in the formula (1) is independently an acryloyl group or a methacryloyl group, and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms, and  $n$  is an integer of 1 or more, at the hologram recording section, [[and]]

wherein the hologram layer has 0.016 or more of refractive index modulation ( $\Delta n$ ) between its low refractive index region and its high refractive index region; and  
wherein the binder resin comprises an organic-inorganic hybrid polymer.

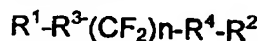
25. – 29. (cancelled)

30. (currently amended) The volume hologram recording photosensitive composition according to claim 1, which further comprises a ~~fluorine~~ fluorene skeleton-containing radical photopolymerizable compound having a refractive index different from that of the fluorine-containing photosensitive compound represented by the formula (1).

31. (previously presented) The volume hologram recording photosensitive composition according to claim 1, wherein the sensitizing dye is 3-ethyl-5-[(3-ethyl-2(3H)-benzothiazolilidene)ethylidene]-2-thioxo-4-oxazolidinone.

32. (currently amended) A volume hologram recording photosensitive composition, comprising a fluorine-containing photoreactive compound represented by the following formula (1), a photopolymerization initiator and, as a sensitizing dye, 3-ethyl-5-[(3-ethyl-2(3H)-benzothiazolilidene)ethylidene]-2-thioxo-4-oxazolidinone:

Formula (1):



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wherein each R<sup>1</sup> and R<sup>2</sup> in the formula (1) is independently an acryloyl group or a methacryloyl group, and each of R<sup>3</sup> and R<sup>4</sup> is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms, [[and]] n is an integer of 1 or more, and wherein the binder resin comprises an organic-inorganic hybrid polymer.

33. (previously presented) The volume hologram recording photosensitive composition according to claim 32, which further comprises a binder resin.

34. (previously presented) The volume hologram recording photosensitive composition according to claim 33, wherein the binder resin comprises at least one selected from the group consisting of a thermoplastic resin, a thermosetting resin, an organic-inorganic hybrid polymer and an organic metal compound represented by the formula (4):

Formula (4):



wherein M' represents a metal such as Ti, Zr, Zn, In, Sn, Al or Se, and R'' represents an alkyl group having 1 to 10 carbon atoms, and n' is the valence number of the metal M'.

35. (previously presented) The volume hologram recording photosensitive composition according to claim 32, which further comprises a cationic photopolymerizable compound which is a second refractive index modulating component other than the fluorine-containing photoreactive compound.

36. (previously presented) The volume hologram recording photosensitive composition according to claim 32, wherein the cationic photopolymerizable compound has a fluorene skeleton.

37. (currently amended) A volume hologram recording photosensitive medium, having a hologram recording section made of a volume hologram recording photosensitive composition comprising a fluorine-containing photoreactive

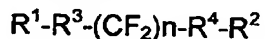


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compound represented by the following formula (1), a photopolymerization initiator and, as a sensitizing dye, 3-ethyl-5-[(3-ethyl-2(3H)-benzothiazolilidene)ethylidene]-2-thioxo-4-oxazolidinone:

Formula (1):



wherein each of  $R^1$  and  $R^2$  in the formula (1) is independently an acryloyl group or a methacryloyl group, and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms,  $n$  is an integer of 1 or more, and wherein the binder resin comprises an organic-inorganic hybrid polymer.

38. (currently amended) A volume hologram having a hologram layer, wherein the hologram layer is formed by exposing to light, a volume hologram recording photosensitive medium having a hologram recording section made of a volume hologram recording photosensitive composition comprising a fluorine-containing photoreactive compound represented by the following formula (1), a photopolymerization initiator and, as a sensitizing dye, 3-ethyl-5-[(3-ethyl-2(3H)-benzothiazolilidene)ethylidene]-2-thioxo-4-oxazolidinone:

Formula (1):



wherein each of  $R^1$  and  $R^2$  in the formula (1) is independently an acryloyl group or a methacryloyl group, and each of  $R^3$  and  $R^4$  is independently a single bond or a bivalent hydrocarbon group having 1 to 5 carbon atoms and  $n$  is an integer of 1 or more, at the hologram recording section,  $n$  is an integer of 1 or more,

wherein the hologram layer has 0.016 or more of refractive index modulation ( $\Delta n$ ) between its low refractive index region and its high refractive index region; and wherein the binder resin comprises an organic-inorganic hybrid polymer.

39. – 48. (cancelled)